International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 04 | April - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Floor Cleaning Robot

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Abstract An advanced cleaning tool intended to improve and automate floor care is a floor cleaning robot. For effective and comprehensive floor cleaning, this system combines multipurpose cleaning mechanisms, Al-driven navigation, and intelligent sensors. With the use of revolving brushes, suction technology, water spray, and quick drying mechanisms, the machine's automated wet and dry cleaning system can remove moisture,grime, and stains in a single pass. By efficiently avoiding furniture and other obstacles, smart mapping and obstacle detection maximise cleaning paths and offer a sanitary, environmentally responsible, and time-efficient method of maintaining spotless floors. The future of automated cleaning technology is embodied by the Smart Floor Cleaner and Dryer, which improves convenience and hygiene with minimal human help.

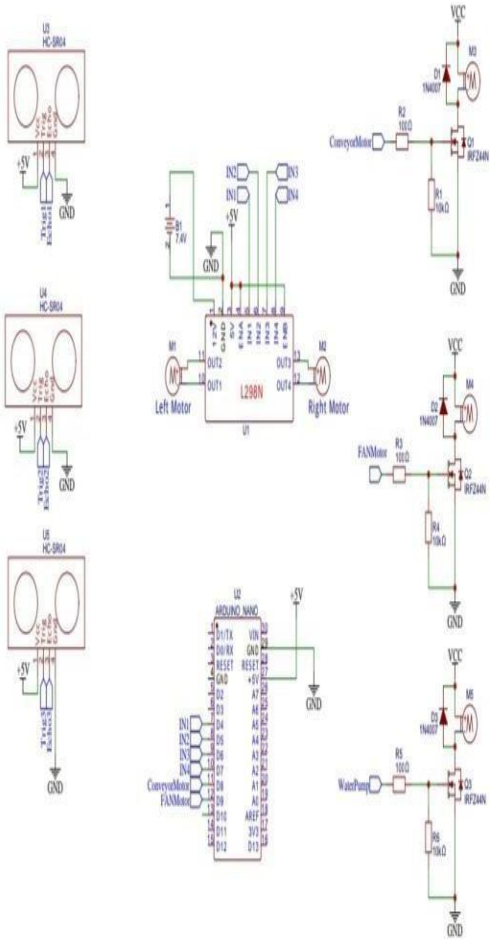
1. INTRODUCTION

Autonomous floor cleaners robots have been developed and changed the cleaning industry over the past few years with the help of Robotics and Artificial intelligence. These robots do a variety of cleaning duties with little to no assistance from humans; vacuum, sweep, mope, and scour. Floor cleaning robots use self-navigating controls, machine learning and advanced sensors to move around different spaces, avoid obstacles and adjust to different floor kinds such as carpets, tiles and wood.

This paper will focus on; Description and an analysis of the technology used in floor cleaning robots, the implications of adopting the technology in cleaning and further implications in the marketing of cleaning services. The need for automation in household and commercial cleaning has risen due to the need for time management, ease of use and generally better cleanliness. The advantages of floor cleaning robots are obvious – they are time-saving and energy-efficient and can access areas that would be difficult for a person to reach. There are many new models that come with Wi-Fi and mobile app controls, as well as voice controls, that let you set a cleaning schedule and check the status of your cleaner remotely. It also has a self-charging feature that enables the robot to work continuously without having to be attended to, thus making these robots useful in the modern smart homes and workplaces

Although they are gradually gaining popularity, there are still some issues concerning the affordability, cleaning effectiveness, and the simplicity of the environment. Current research is aimed at increasing the precision of the navigation system, extending the battery life and creating better cleaning devices. This paper discusses the design, the features, and the effectiveness of the floor cleaning robots, comparing their advantages and disadvantages and looking at their future in residential and commercial applications.

2. SYSTEM IMPLEMENTATION



A. Working of floor cleaning robot :-

To automate the cleaning process, the floor cleaning robot is designed to use microcontroller based control, motorized movement and wireless communication. The Arduino Nano is the control of the system that controls input signal from the HC-05 Bluetooth module that helps in the remote control of the robot using a smartphone app. The Bluetooth module communicate with the Arduino by using its TX and RX pins so that it can operate wirelessly without any issue.

To achieve movement, the robot employs an L298N motor driver which controls two DC gear motors (right and left motors) according to the signals received from the Arduino. The motor driver is used to move the robot in forward, backward, left and right direction as per the choice of the user. The power supply is done using a 7.4V battery and Arduino works on 5V voltage to manage the power efficiently. The cleaning system consists of three major parts: An IRFZ44N MOSFET controls a water pump, a scrubber, and a fan motor. The water pump receives its input from a bottle and injects the cleaning solution into the floor through a tube. The conveyor motor rotates the scrubber which in turn rotates and scrubs, hence cleaning the floor. In the last step, the fan motor blows air over the surface of the cleaned area to dry it. The MOSFETs are used to control power to these components and the resistors and diodes are used to prevent voltage spikes and back-emf respectively. The entire system is supported by an 8mm PVC sheet and has wheels for a smooth movement. The zero PCB board and wires are used for establishing the electrical connections and make it more robust. The robot is made to be durable by use of screws and adhesive (Feviquick). The user gives instructions to the robot through a Bluetooth enabled smartphone and Arduino works on the signals received to control the motors and cleaning activities of the robot. This makes it possible to have a remote controlled, time saving and effective autonomous floor cleaning machine that does not require the user to get their hands dirty.

The integration of smart technologies, including IoT and automation principles, makes this system a potential solution for modern, intelligent cleaning applications in homes, offices, and industries.

B. Components used:-

1. HC-05 Bluetooth Module: Enables Bluetooth-enabled devices, such as smartphones, to communicate wirelessly. gives the Arduino Nano instructions.
2. Arduino Nano: Processes commands from the Bluetooth module and serves as the primary controller. uses signals received to control various motors and parts.
3. MOSFETs: Used to regulate and switch power to three parts: Conveyor motors are used to move items along conveyors. Fan motor: Offers cooling or ventilation. Water Pump: Moves liquid when needed. 4.L298 Motor Driver: Manages the motion of the left and right motors. receives data from the Arduino Nano to control direction and speed, as well as power from the 7.4V battery.
5. A 7.4V battery powers the entire system, including the Arduino, motors, and other parts.

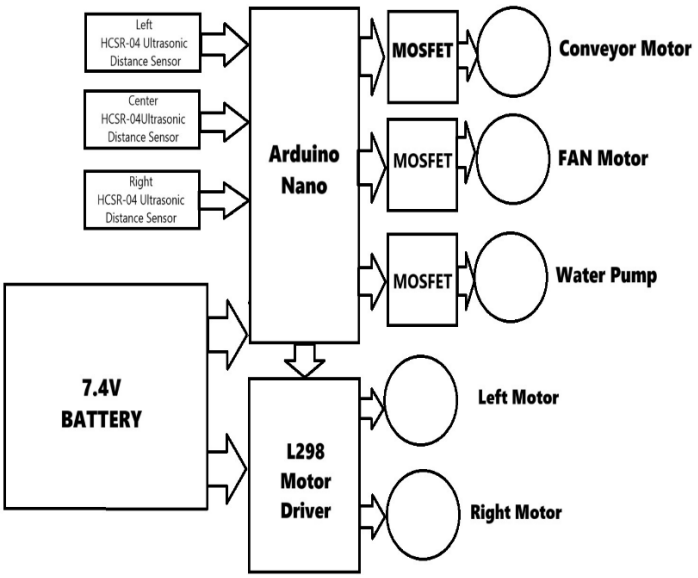


Fig -4: Block building

ADVANTAGES

1. Automation and Convenience: They are less labour intensive and can be scheduled to clean at certain intervals.

2. Time and Labour Efficiency: This is useful for people and organizations with a busy schedule, as it performs the cleaning tasks on its own.

3. Advanced Navigation: With sensors and Artificial Intelligence, they can create a map of a room and move around in it to clean, while also recognizing and avoiding obstacles

4. Multi Surface Cleaning: Adapt to different types of surfaces, from carpets, through hardwood floors, to tiles.

5. Energy Efficiency – Use less power than traditional vacuum cleaners; therefore, an eco friendly choice.

6. Self-Charging – Pots to go back to their dock when the battery is low to keep on working.

7. Smart Home Integration You can control them via mobile apps and voice assistants for remote operation.

APPLICATIONS

1. Household Cleaning: In other words, these robots are engaged in performing menial, routine cleaning duties, and hence save human labour, while at the same time, maintaining the cleanliness of the household with minimal supervision.
2. Commercial and Industrial : They can dependably and quickly cover large areas, which allows them to increase productivity in offices, retail centres factories, and at the same time reducing the operating costs
3. Healthcare & Hospitals: Therefore, they improve infection control, avoid and reduce risk of contact with potentially contaminated surfaces
4. AI and Automation Research: Hence, these robots with autonomous navigation and decision-making capabilities are used as a test platform for AI, machine learning, and sensor technologies.
5. IoT and Smart Home Integration: Some of the current cleaning robots are capable of connecting to IoT systems to enable remote scheduling, monitoring and optimisation for the user's convenience
6. Environmental Impact: Some models are designed with energy efficient technology and environmentally friendly cleaning products, thereby reducing chemical usage and encouraging sustainable behavior.

3. FUTURE SCOPE

1. Enhanced AI and Machine Learning Future robots shall have deep learning for better navigation, obstacle avoidance and adaptive cleaning. They will learn for themselves and improve and optimize their performance from real time data.
2. Smart Home and IoT Integration

The robots will integrate seamlessly with smart home devices to provide remote monitoring and automated scheduling. This makes the user life easier through voice command compatibility.

3. Advanced Sensor and Vision Technologies

LiDAR and AI driven object recognition will improve mapping and obstacle detection. Advanced sensors will improve edge and corner cleaning effectiveness

4. Sustainable and Eco-friendly Innovations Future models will be using biodegradable cleaning agents and energy efficient batteries. The self cleaning features will reduce the need for maintenance and the environmental effects.
5. Multi functionality and Versatility They will incorporate vacuuming, mopping and air purification.
6. Autonomous Maintenance and Self-repair

AI-powered diagnostics will enable predictive maintenance. Modular designs will allow self-repair and component replacements without manual intervention.

7. Commercial and Industrial Applications

Large-scale robots will clean malls, hospitals, and airports. AI-driven fleet management will optimize cleaning operations in smart cities.

8. Cost Reduction and Accessibility

Affordable models and subscription-based services will increase adoption. Government and corporate incentives will further boost market growth.

4. CONCLUSIONS

In conclusion, the "Floor Cleaning Robots" project stands as a the automated vacuum cleaners; they are the very sophisticated platforms which are able to perform adaptive cleaning, have real time obstacle detection and are able to be integrated with smart home systems as the development of floor cleaning robots incorporates artificial intelligence, automation, and sensor technologies. In the future of floor cleaning robots are expected to have more focus on AI autonomy, multifunctionality, and sustainability. IoT connectivity, self-diagnostics features, and environmentally friendly solutions will further enhance the market's development and popularity. Ongoing enhancements in battery technology, machine learning algorithms, and value engineering will ensure that floor cleaning robots are an essential part of both residential and commercial cleaning applications. These robots will not only increase the efficiency of cleaning but also lead to the development of a smarter, more sustainable living environments

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